

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Previously Presented) A voltage-controlled oscillator comprising:

an inductor circuit having an inductor;

n pieces (n is two or more) of variable capacitance circuit having a variable capacitance element and having blocking capacitors of interrupting a direct current at both ends thereof, said n pieces of variable capacitance circuit including first, second and third variable capacitance circuits, a negative resistance circuit, and reference voltage generation means of generating a reference voltage from a power supply voltage, and wherein:

said inductor circuit, said n pieces of variable capacitance circuit and said negative resistance circuit are connected in parallel;

a predetermined reference voltage is inputted to some terminals of the variable capacitance elements of said n pieces of variable capacitance circuit;

a control voltage of feedback-controlling an oscillation frequency is inputted to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits;

said n pieces of variable capacitance circuit are connected in parallel so that each capacitance variation characteristic against said control voltage inputted to said variable capacitance circuit has the same directional characteristic;

said control voltage inputted to said n pieces of variable capacitance circuit is the same voltage; and

of said n pieces of variable capacitance circuits, a first reference voltage is inputted to one of the terminals of said first variable capacitance circuit, a second reference voltage is inputted to one of the terminals of said second variable capacitance circuit and a third reference voltage is inputted to one of the terminals of said third variable capacitance circuit and said first, second and third reference voltages are fixed and different from each other.

2. (Original) The voltage-controlled oscillator according to claim 1, wherein, when said n pieces of variable capacitance circuits are arranged in decreasing order of reference voltages inputted to said n pieces of variable capacitance circuits, a difference between the voltage inputted to one terminal of the variable capacitance element of an m-th (m is between 2 and n) variable capacitance circuit and the voltage inputted to one terminal of the variable capacitance element of an m-1-th variable capacitance circuit is V_d .

3. (Original) The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected n+1 pieces of resistor, and said n pieces of reference voltage are generated by having said power supply voltage divided by said series-connected n+1 pieces of resistor.

4. (Original) The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected one resistor and n pieces of diode, and said n pieces of reference voltage are generated by having said power supply voltage divided by said series-connected one resistance and n pieces of diode.

5. (Original) The voltage-controlled oscillator according to claim 4, wherein said diodes are formed by transistors having bases and collectors thereof shorted.

6. (Original) The voltage-controlled oscillator according to claim 3, wherein said reference voltage generation means further has an active filter.

7. (Original) The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected one active filter and n pieces of resistors, and said n pieces of reference voltage are generated by having said power supply voltage divided by said series-connected one active filter and n pieces of resistors.

8. (Original) The voltage-controlled oscillator according to claim 1, wherein output sides of outputting said reference voltages of said reference voltage generation means are grounded via capacitive elements respectively.

9. (Original) A voltage-controlled oscillator according to claim 1, further having connected in parallel thereto a frequency band setting variable capacitance circuit having a variable capacitance element, having a power supply voltage inputted to one terminal of said variable capacitance element and having a voltage according to a frequency band to be used of a plurality of voltages inputted to the other terminal of said variable capacitance element so as to change a capacitance of said variable capacitance element, wherein, when the capacitance of the variable capacitance element of said first variable capacitance circuit becomes less than a predetermined value, a variable range is reduced as to the capacitance of at least one variable capacitance circuit of said n pieces of variable capacitance circuit.

10. (Original) The voltage-controlled oscillator according to claim 9, wherein at least one variable capacitance circuit of said n pieces of variable capacitance circuit has the variable capacitance element connected in parallel to said variable capacitance element, and the voltage according to a frequency to be used of said plurality of voltages is inputted to the other terminal of one of said variable capacitance elements instead of said control voltage so that the variable range is reduced as to the capacitance of at least one variable capacitance circuit of said n pieces of variable capacitance circuit according to the reduction in the

capacitance of the variable capacitance element of said frequency band setting variable capacitance circuit.

11. (Original) The voltage-controlled oscillator according to claim 9, wherein said blocking capacitor is comprised of two or more capacitors connected via a switch, and said switch is off or on according to the frequency to be used so that the capacitance of said blocking capacitors is reduced and a variable range of the capacitance of at least one of said n pieces of variable capacitance circuit is reduced.

12. (Original) The voltage-controlled oscillator according to claim 1, wherein said variable capacitance element operates by utilizing a gate capacitance of an MOS transistor.

13. (Cancelled)

14. (Cancelled)

15. (Cancelled)

16. (Cancelled)

17. (Previously Presented) A radio communication apparatus having a PLL circuit of outputting a signal of a target frequency having the voltage-controlled oscillator according to claim 1.

18. (Previously Presented) A voltage-controlled oscillation method of a voltage-controlled oscillator comprising:

an inductor circuit having an inductor;

n pieces (n is two or more) of variable capacitance circuit having a variable capacitance element and having blocking capacitors of interrupting a direct current

at both ends thereof, said n pieces of variable capacitance circuit including first, second and third variable capacitance circuits, a negative resistance circuit, and reference voltage generation means of generating a reference voltage from a power supply voltage, with said inductor circuit, said n pieces of variable capacitance circuit and said negative resistance circuit connected in parallel, and including:

a step of inputting a predetermined reference voltage to some terminals of the variable capacitance elements of said n pieces of variable capacitance circuit; and

a step of inputting a control voltage of feedback-controlling an oscillation frequency to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits, and

said n pieces of variable capacitance circuit are connected in parallel so that each capacitance variation characteristic against said control voltage inputted to said variable capacitance circuit has the same directional characteristic;

said control voltage inputted to said n pieces of variable capacitance circuit is the same voltage; and

of said n pieces of variable capacitance circuits, a first reference voltage is inputted to one of the terminals of said first variable capacitance circuit, a second reference voltage is inputted to one of the terminals of said second variable capacitance circuit and a third reference voltage is inputted to one of the terminals of said third variable capacitance circuit and said first, second and third reference voltages are fixed and different from each other.

19. (New) A voltage-controlled oscillator comprising:

an inductor circuit having an inductor;

n pieces (n is three or more) of variable capacitance circuit having a variable capacitance element and having blocking capacitors of interrupting a direct current at both ends thereof, said n pieces of variable capacitance circuit including first, second and third variable capacitance circuits,

a negative resistance circuit, and

reference voltage generation means of generating a reference voltage from a power supply voltage, and wherein:

said inductor circuit, said n pieces of variable capacitance circuit, and said negative resistance circuit are connected in parallel;

a predetermined reference voltage is inputted to some terminals of the variable capacitance elements of said n pieces of variable capacitance circuit;

a control voltage of feedback-controlling an oscillation frequency is inputted to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits;

said n pieces of variable capacitance circuit are connected in parallel with each other so that each capacitance variation characteristic against said control voltage inputted to said variable capacitance circuit has the same-directed characteristic;

said control voltage inputted to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits is the same voltage;

of said n pieces of variable capacitance circuits, a first reference voltage is inputted to one of the terminals of said first variable capacitance circuit, a second reference voltage is inputted to one of the terminals of said second variable

capacitance circuit, and a third reference voltage is inputted to one of the terminals of said second variable capacitance circuit;

said first reference voltage, said second reference voltage, and said third reference voltage are fixed respectively; and

a first difference between said first reference voltage and said second reference voltage and a second difference between said second reference voltage and said third reference voltage are different from each other.

20. (New) The voltage-controlled oscillator according to claim 19, wherein at least one of said first variable capacitance circuit, said second variable capacitance circuit, and said third variable capacitance circuit is an accumulation MOS.

21. (New) A radio communication apparatus having a PLL circuit of outputting a signal of a target frequency, said PLL circuit having the voltage-controlled oscillator according to claim 19.

Respectfully submitted,


Lawrence E. Ashery, Reg. No. 34,515
Attorney for Applicants

LEA/ds

Dated: January 3, 2007

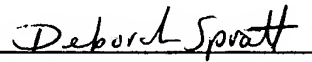
P.O. Box 980
Valley Forge, PA 19482
(610) 407-0700

The Director is hereby authorized to charge or credit Deposit Account No. **18-0350** for any additional fees, or any underpayment or credit for overpayment in connection herewith.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, with sufficient postage, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on:

January 3, 2007

Deborah Spratt



ds/97952